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Biometric characteristics of rice cultivars

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Resumo

O objetivo deste trabalho foi avaliar as características biométricas de 62 cultivares de arroz, pertencentes às subespécies Indica e Japónica, sendo comercializados diferentes tipos, como é o caso do Agulha, Carolino, Aromático, Integral, Risotto, Selvagem e o arroz vaporizado. Verificou-se que para o mesmo tipo de arroz existiram grandes diferenças. De um modo geral o arroz Agulha, Carolino, Aromático e Integral comercializados em Portugal são longos. No caso do arroz Glutinoso uma das cultivares é longa e a outra é redonda (comprimento menor que 5 mm e relação comprimento/ largura menor que 1.9). Todas as cultivares apresentaram valores elevados de brancura vítrea, brancura total, e uma pequena percentagem de área gessada.

Palavras chave: Arroz; biometria; morfologia; cor.

Contribution for the characterization of carolino rice cultivars

Abstract

The objective of this work was to evaluate the grain biometric characteristics of 62 rice cultivars, which cover *Indica* and *Japonica* subspecies, and different types of commercial rice like, Agulha (*Indica* rice cultivars), Carolino (*Japonica* cultivars), aromatic (basmati and thai), integral rice, risotto, glutinous (waxy), wild and parboiled rice. It was noticed that for the same group type of rice there are a great variance. Generally, the Agulha, Aromatic and Integral rices commercialized in Portuguese trade are long (length high than 6 mm and length/width ratio higher than 3) and risotto cultivars are medium size. The two studied glutinous rice cultivars presented one cultivar long and other cultivar round (length lower than 5 mm and length/width ratio lower than 1.9). All rice cultivars presented high values of white vitreous, total whiteness, and low percentage of chalky area, presenting a crystalline and translucent aspect, but there is an exception to integral rice cultivars due to absence of polish operation during the milling process and for parboiled rice cultivars due to the effects of parboiled treatment. Moreover the vitreous percentage was also high. There was a strong correlation between the white vitreous values and total whiteness.

Keywords: Rice cultivars; biometry; morphology; color.

Introduction

Rice (*Oryza sativa* L.) is a member of *Gramineae* family and it is one of the most important cereals cultivated worldwide, constituting the basic food for large number of human beings, sustaining two-thirds of the world population (Zhout et al., 2002). Rice is consumed mainly as whole grain, and quality considerations are much more important than for any other food crop. Rice grain quality preference varies from country to country and among regions.

The geometric structure and weight of rice kernels determine the physical characteristics and types of rice grains (shape, volume and density). Grain shape, which is defined as the ratio of kernel length to kernel width, is used by the rice industry to classify the different species and varieties. Many studies have shown that the physical characteristics of the rice grain are associated with the yield of head rice.

Grain-type preferences vary among consumer groups. The marketing values of rice as an agricultural product depend on its physical qualities after the harvesting. The percentage of whole grain is the most important parameter for the rice processing industry (Marchezan, 1991), related with a common demand to all rice consumers, the grain, or head rice, be well polished and unbroken. The geometric structure and weight of rice (*Oryza sativa* L.) kernels determine the physical characteristics and types of rice grains (shape, volume and density). The milled rice grain is classified for dimensions, according to the Portuguese legislation (D.L. 62/2000), in long, medium and short/round. Thus, grain shape, considering the length and the ratio of kernel length to kernel width, is used by the rice industry in Portugal to classify rice into three types: round grain (length ≤ 5.2 mm and length/width ratio < 2.0), medium grain (length between 5.2 and 6 mm and length/width ratio < 3), and long grain rice type A (length > 6 mm and length/width ratio of 2–3) and Type B (length > 6 mm and length/width ratio ≥ 3).

The degree of milling or polishing (e.g. polishing time and polishing pressure) is an important factor that influences the quality of milled rice. Excessive polishing often leads to a high degree of breakage (Sahay et al. 1980). In contrast, a low degree of milling can yield a low-quality head rice which will reduce its market value as a result of the incomplete removal of the aleurone layers from the kernel (Jongkaewwattana and Geng, 2002). The milling operation will influence morphological characteristics as white vitreous, total whiteness, vitreous percentage chalky area, and kett (reflective index). These characteristics could be changed after cooking, as it is the case of chalkiness. The chalkiness cannot be seen after cooking, it is an important physical property as it can determine whether a particular rice sample attracts a competitive price on the market (Khush et al., 1979; Indudhara and Bhattacharya, 1982).

The objective of this work is, therefore, to evaluate the grain biometric and morphological characteristics of 62 cultivars commercialized in Portugal.

Material and Methods

Sixty two samples of milled rice grains were collected from the Portuguese trade market, and they were coded with a letter and a number (the cultivar names were not revealed due to confidential reasons). The species were *Indica* and *Japonica* subspecies, and different types of commercial rice like, Agulha (A, with 19 *Indica* rice cultivars), Carolino (C, with 14 *Japonica* cultivars), aromatic (Ar, with 3 basmati and 2 thay cultivars), integral rice (I, with 2 cultivars), risotto (Ri, with 10 cultivars), glutinous (G, with 2 waxy cultivars), Selvagem (S, with 1 cultivar, wild rice) and Vaporizado (V, with 7 cultivars, parboiled rice). Generally, these types of rice are the ones commercialized in Portugal, and in Carolino case they are exclusively produced in Portugal.

Biometric characteristics of all rice grains were evaluated, using an automatic S21(LKL, Brasil) biometric equipment and a C-300 (Kett, USA) colorimeter. An average of 700 grains for each cultivar were analysed. The evaluated characteristics were length, width, length/width ratio. Other morphological characteristics were evaluated: white vitreous, total whiteness, vitreous percentage, percentage of chalky area and kett. These determinations were done using an automatic S21(LKL, Brasil) biometric equipment and a C-300 (Kett, USA) colorimeter. An average of 670 grains for each cultivar was analysed.

All of the data represents averages of at least three different determinations. Results were analysed using the SPSS® for Windows version 17.0 software. The data was subjected to one-way analysis of variance (ANOVA) test. Pearson correlation coefficients (r) for the relationships between properties were also calculated. The level of significance used for all the statistical tests was 95%.

Results and Discussion

The marketing values of rice as an agricultural product depend on its physical qualities after the harvesting (Ghadge, and Prasad, 2012). The percentage of whole grain is the most important parameter for the rice processing industry (Marchezan, 1991).

The degree of milling or polishing (e.g. polishing time and polishing pressure) is an important factor that influences the quality of milled rice. Excessive polishing often leads to a high degree of breakage (Sahay et al. 1980). In contrast, a low degree of milling can yield a low-quality head rice which will reduce its market value as a result of the incomplete removal of the aleurone layers from the kernel.

Generally, the rices studied are long (length high than 6 mm and length/width ratio higher than 3) like Agulha, Aromatic and Integral (except one cultivar) rices commercialized in Portuguese trade (Figure 1). In this category there are two types, A-type with a ratio length/width lower than 3 mm, and B-type with a ratio length/width more than 3 mm. The Agulha rices are B-type, and the Carolino rices are A-type. The Integral cultivars presented also different classifications, the I1 is Long A-type and the I2 is Long B-Type. These differences between samples in the same cultivars, are also noticed in the two studied glutinous rice cultivars which presented one cultivar long and other cultivar round (length lower than 5 mm and length/width ratio lower than 1.9). The Selvagem (wild) cultivar was the one with high length value, and also high length/ width value.

The uniformity of the physical characteristics of kernels plays an important role in determining the recoverable amount of head rice. Thus, rough rice is milled on the basis of a large quantity of grains rather than individual grains, the milling equipment conditions are fixed for a given grain type. For this reason, for example, when kernels of one batch have variable densities and are subjected to a moderate degree of milling, the kernels of lower density may crack more easily than those of higher density. Kernels with similar density and other physical characteristics should respond similarly to a given set of milling conditions which can then be adjusted to optimum. Also, the uniformity of kernel characteristics has an important influence on the percentage of head rice recovery, one of the most important factors in determining a grower's income (Jongkaewwattana and Geng, 2002).

Consider the vitrea whitness (≥ 120), total whitness (≥ 120), and vitrea percentage (≥ 80%), generally samples presented similar behaviours. The Vaporizado (parboiled) rices also presented lower vítrea whitness and total whitness, and the Agulha simple A11 presented similar values to parboiled rices. The Glutinoso and Selvagem samples presented values completely different. The Glutinoso rices presented high values of total whiteness (≥ 160) and low vitrea % (≤ 60%). Furthermore, the Glutinoso rices presented also high values of chalky area (≥ 80) (Figure 1), and completely distinct from the other rice samples, being also high for Risotto rices. Chalkiness indirectly contributes to rice breakage through easier cracking (Bhattacharya, 1980). Although chalkiness cannot be seen after cooking, it is an important physical property as it can determine whether a particular rice sample attracts a competitive price on the market (Khush et al., 1979; Indudhara and Bhattacharya, 1982).

The Selvagem rice and Integral rices presented the lowest kett values (reflective index with a range of 5-70), which it is expected due to the absence of polish operation during the milling process.

It was also found a stickily relationship between the total and vitrea whiteness, with r^2 between 0.75 and 0.99.

Thus, the knowledge of these physical properties of rice cultivars is of fundamental importance during the harvesting of grains, transporting, design and dimensioning of correct storage procedure, manufacturing and operating different equipments used in post harvesting main processing operations of these products (Ghadge, Vairagar, and Prasad, 2008).

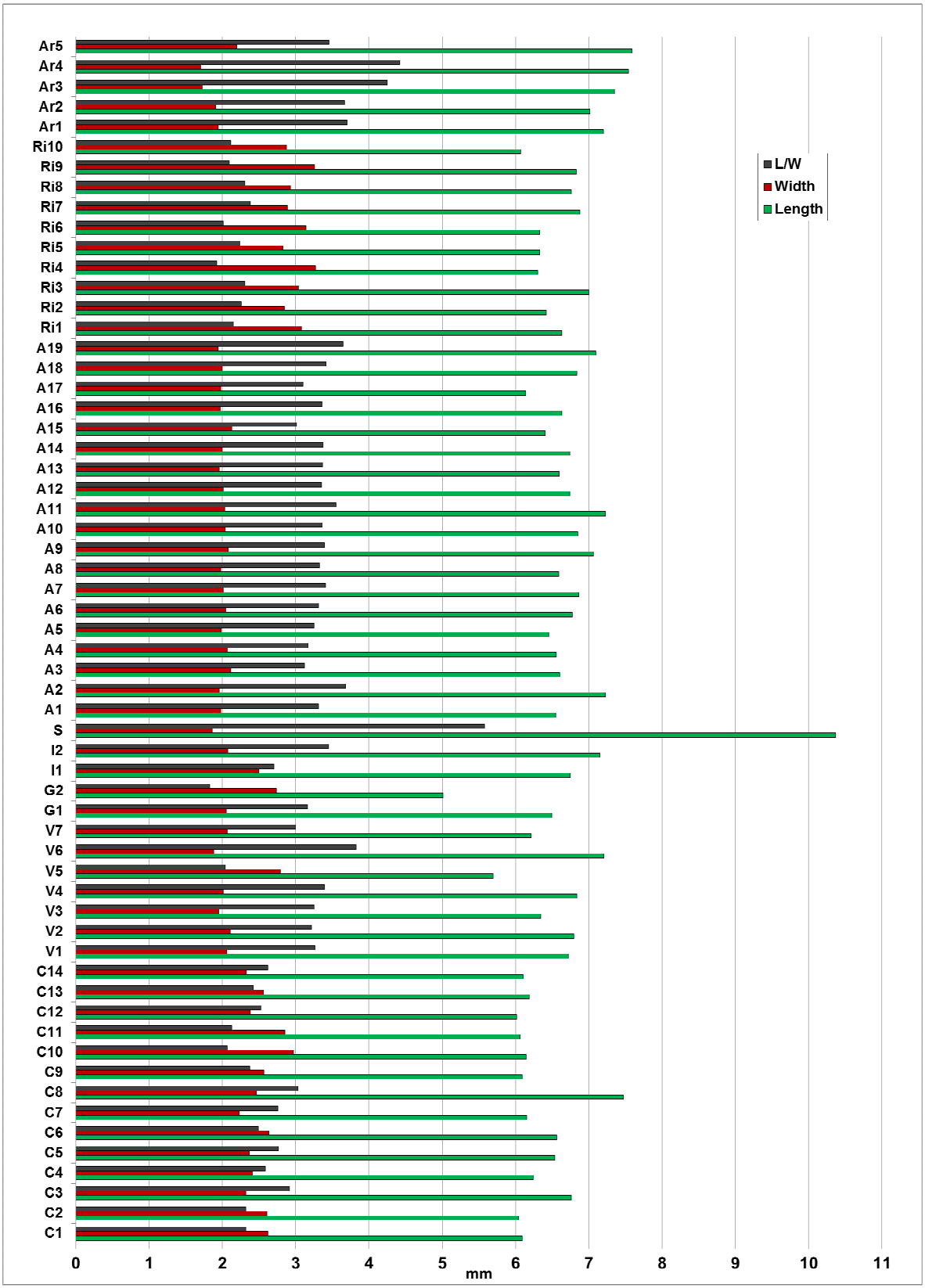

Figure 1. Length and width of rice cultivars.

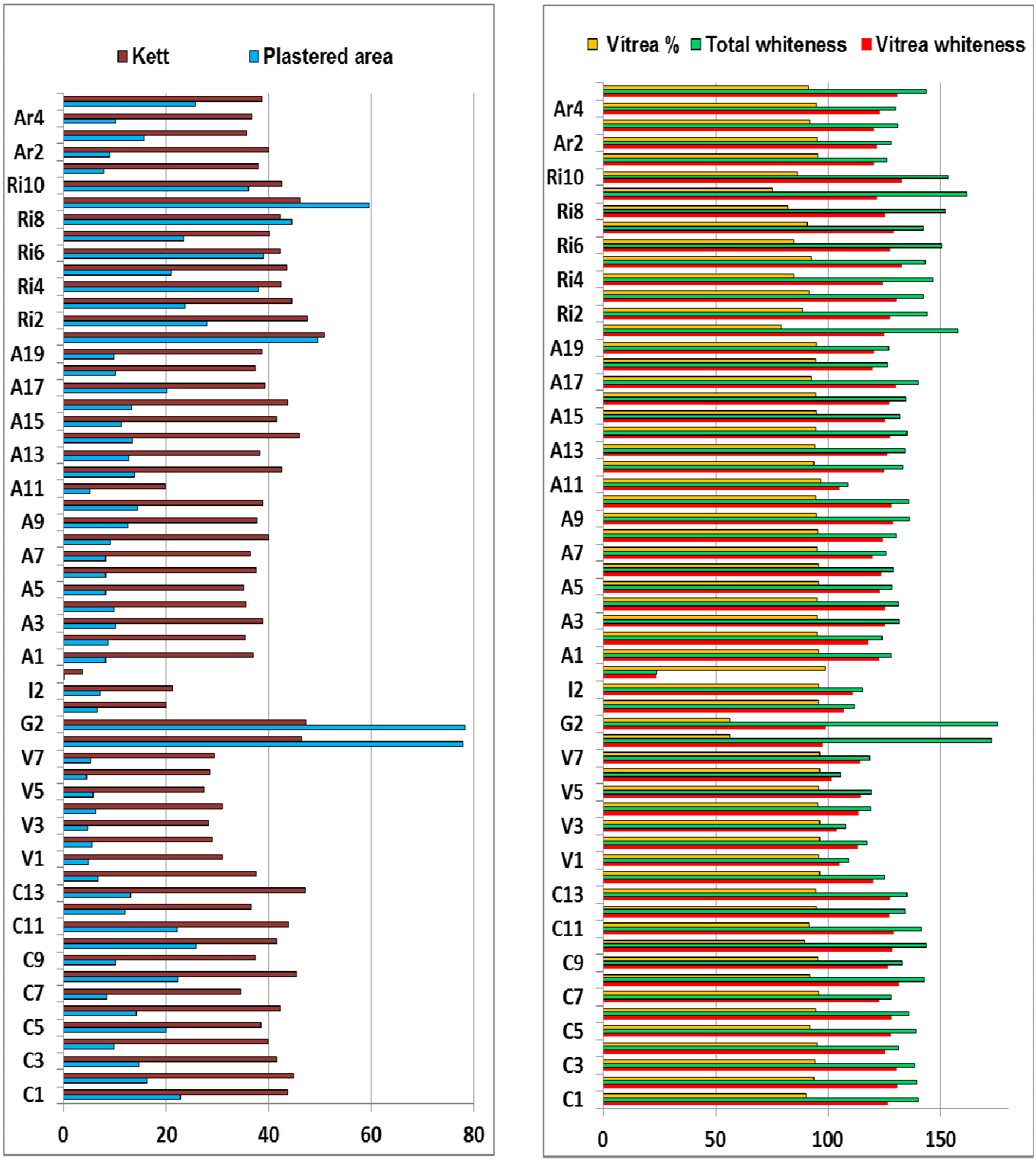

Figure 2. Whiteness, vitrea, plastered area and kett of rice cultivars.

Conclusions

Generally it could be concluded that cultivars studied exhibited good physical characteristics especially milling recoveries, shape and low incidence of chalkiness. In Portuguese trade long rices are marked leaders due to consumers wishes and needs. All rice cultivars presented high values of white vitreous, total whiteness, vitreous percentage and low percentage of chalky area, presenting a crystalline and translucent aspect, but there is an exception to Integral rice cultivars due to absence of polish operation during the milling process and for parboiled rice cultivars due to the effects of parboiled treatment. It was also observed that Selvagem and Glutinoso rices are quite diferente from the other rice cultivars. Even for the same type of rice there are samples with different biometric characteristics, such as in Agulhas rices with A11 sample, meaning that are a high variability in biometric and morphological measurements. Thus, these characteristics are very important to the milling process operations.

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